U. S. NAVAL RADIOLOGICAL DEFENSE LABORATORY
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From: Commanding Officer and Director
To: Director, Grants and Research Contracts Division, NASA (Code SC)

Subj: Quarterly Progress Report for July - September 1965; forwarding of

Ref: (a) NASA ltr file SC of 25 May 1964
(b) NASA ltr file SC/05-023-025/R-142/WW of 19 Oct 1964

Encl: (1) Quarterly Progress Report, Jul - Sep 1965 (25 cys)

1. Enclosure (1), covering work performed under Funds Transfer R-142 July - September 1965, is forwarded as requested in references (a) and (b).

Robert C. Lilly
ROBERT C. LILLY
By direction

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NASA List "A"

1. Title: Heavy Particle Dosimetry for Long Range, Manned Space Flight

2. Sponsor and Task Number: National Aeronautics and Space Administration, Subtask A-65315

3. Principal Investigator: E. V. Benton

4. Objective: To conduct fundamental studies with solid state detectors and nuclear emulsions aimed at developing a heavy ion dosimeter for the measurement of dose from the primary cosmic radiation. The dosimeter is intended for use in long range manned space flights. Experimental studies will be made with charged particle track recording plastics which are capable of covering a wide range of sensitivity. By developing a sufficient number of such materials, each with a different threshold energy for heavy particles, it is hoped that a composite picture of the total radiation exposures from primary cosmic rays can be obtained.

5. Progress and Results: Instruments and techniques required for the implementation of this program are currently being developed. The available sources of heavy ions (Cf^{252}, Am^{241}) have been calibrated with the use of nuclear emulsions. A constant temperature bath for the chemical etching of exposed plastic samples has been built. A digitized filar micrometer for the precise and rapid measurement of track lengths has been built and calibrated. An apparatus for determining the sensitivity of various plastic detectors to He^4 ions of different energies is under construction.

Since most plastics used as charged particle detectors are not commercially available, techniques for preparing the samples had to be developed. Two different plastics are being used: cellulose nitrate and cellulose acetate butyrate. Of the two, the former is slightly more sensitive and appears to hold the greatest promise as a charged particle detector of maximum sensitivity.

Track delineation methods are being currently investigated in the two materials to determine conditions for optimum track formation. The chemical etching of samples with different reagent materials are being studied as a function of reagent concentration and temperature.

Plastics were prepared and flown on the Gemini IV space flight. While only a small number of heavy particles were observed, valuable experience was gained in preparing for future flights.

6. Plans for Next Period:

FY 1966: Continue the study of the chemical and physical parameters of cellulose nitrate pertinent to charged particle detection. Develop a method for measuring the sensitivity of the plastic detectors using He^4 ions emitted by Am^{241}. Calculate range-energy relations for heavy ions in the various plastic detector materials. Prepare and fly samples of plastic detectors on available "Gemini" space flights. A report "Charged Particle Tracks in Polymers," will be completed by the end of the fiscal year.

7. Technical Reports Prepared during this Period: None.

1. Title: Electron Scattering Data Analysis

2. Sponsor and Task Number: National Aeronautics and Space Administration, R-142

3. Principal Investigator: B. W. Shumway

4. Objective: To study the scattering and degradation of monoenergetic electrons within various materials; specifically, to determine the spectral and angular distribution of electrons transmitted through, and reflected from, thick samples of materials.

5. Progress and Results: It has been decided that we need a better matrix for unfolding the electron spectra. This new response matrix will be based upon all previous response measurements. These have been brought together and compared. Because a considerable degree of interpolation will be used for developing the new matrix, we shall need to develop satisfactory mathematical models for the response function. A satisfactory model for the response functions to fit all data appears not to be possible. The best data have been selected and an interpolation model is being tested.

6. Plans for Next Period: Further comparisons will be made, under a related problem, and the mathematical models decided upon. Generation of a new matrix will be then made so that unfolding may proceed. As soon as appropriate portions of the data have been either corrected or proved valid, the results will be brought together into families of curves for the final report. It is hoped that this will enable the problem to be closed out later in FY 1966.

7. Technical Reports Prepared During This Period: None.